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(21)Application number : 2000-071758 (71)Applicant : RICOH CO LTD

(22)Date of filing : 15.03.2000 (72)Inventor : MURANAKA MASAICHI

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(54) APPARATUS AND METHOD FOR DETECTING REMAINING QUANTITY  
OF INK AND INK JET RECORDING APPARATUS

(57)Abstract:

PROBLEM TO BE SOLVED: To accurately detect a remaining quantity of ink stored in an ink cartridge such as a flexible bag, a container or the like.

SOLUTION: A suction quantity of ink sucked by a suction pump 14 from a nozzle of a recording head 3 at an initial time when the cartridge 2 is replaced and when a function of the recording head 3 is recovered is detected. A discharge quantity of ink during printing and a discharge quantity of ink when the ink is purged from the nozzle of the recording head 3 so as to maintain the nozzle of the recording head 3 in a normal state are detected. The detected suction quantity and discharge quantities are subtracted from a total quantity of ink filled in the cartridge or a preliminarily calculated remaining quantity of ink, whereby the remaining quantity of ink in the cartridge 3 is calculated.

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## CLAIMS

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[Claim(s)]

[Claim 1] It is ink residue detection equipment of the cartridge which supplies ink to the recording head which makes ink breathe out from a nozzle. Have the amount detection means of suction, a discharge quantity detection means, and an ink residue operation means, and the amount detection means of suction detects the amount of suction of the ink attracted with a suction pump from the nozzle of a recording head when recovering the function of the time of the first stage which exchanged cartridges, and a recording head. A discharge quantity detection means detects the discharge quantity of the ink when purging ink for the discharge quantity of the ink under printing, and the nozzle of a recording head from the nozzle of a recording head at a \*\*\*\*\* sake at a normal condition. An ink residue operation means is ink residue detection equipment characterized by computing the ink residue in a cartridge by subtracting the discharge quantity detected with the amount of suction and discharge quantity detection means which were detected with the amount detection means of suction from the ink total fill or the ink residue computed previously of a cartridge.

[Claim 2] It has the detector which detects the limitation which the actuator displaced with the internal amount of ink and the actuator displaced. It is ink residue detection equipment of the cartridge which supplies ink to the recording head which makes ink breathe out from a nozzle. It has the amount detection means of suction, a discharge

quantity detection means, an ink residue operation means, and an output means. The amount detection means of suction detects the amount of suction of the ink attracted with a suction pump from the nozzle of a recording head when recovering the function of the time of the first stage which exchanged cartridges, and a recording head. A discharge quantity detection means detects the discharge quantity of the ink when purging ink for the discharge quantity of the ink under printing, and the nozzle of a recording head from the nozzle of a recording head at a \*\*\*\*\* sake at a normal condition. An ink residue operation means computes the ink residue in a cartridge by subtracting the discharge quantity detected with the amount of suction and discharge quantity detection means which were detected with the amount detection means of suction from the ink total fill or the ink residue computed previously of a cartridge. An output means is ink residue detection equipment with which an ink residue is characterized by outputting the signal which shows zero when a detector operates with an actuator, while outputting the computed ink residue.

[Claim 3] It has the detector which detects the limitation which the actuator displaced with the internal amount of ink and the actuator displaced. It is ink residue detection equipment of the cartridge which supplies ink to the recording head which makes ink breathe out from a nozzle. It has the amount detection means of suction, the amount conversion means of suction, a discharge quantity detection means, an ink residue operation means, and an output means. The amount detection means of suction detects the amount of suction of the ink attracted with a suction pump from the nozzle of a recording head when recovering the function of the time of the first stage which exchanged cartridges, and a recording head. The amount conversion means of suction is changed into the number of regurgitation which detects with the amount detection means of suction, and carries out the regurgitation of the amount of suction from a nozzle. A discharge quantity detection means detects the discharge quantity of the ink when purging ink for the discharge quantity of the ink under printing, and the nozzle of a recording head from the nozzle of a recording head at a \*\*\*\*\* sake at a normal condition. An ink residue operation means computes the ink residue in a cartridge by subtracting the discharge quantity detected with the discharge quantity and the discharge quantity detection means which were changed with the amount conversion means of suction from the ink total fill or the ink residue computed previously of a cartridge. An output means is ink residue detection equipment with which an ink residue is characterized by outputting the signal which shows zero when a detector operates with an actuator, while outputting the ink residue computed with the ink residue operation means.

[Claim 4] Ink residue detection equipment according to claim 3 which changes and sets beforehand the ink total fill which becomes settled by the capacity of a cartridge for the above-mentioned ink residue operation means as the number of regurgitation, and computes an ink residue from the number of regurgitation according to the ink total fill,

and the number of regurgitation from the nozzle of a recording head.

[Claim 5] The above-mentioned discharge quantity detection means is ink residue detection equipment according to claim 1 to 4 which carries out counting of the number of regurgitation of a recording head from the number of driving pulses from the drive driver of a recording head, and detects the discharge quantity of ink.

[Claim 6] The above-mentioned discharge quantity detection means is ink residue detection equipment according to claim 5 which detects the discharge quantity of the ink when purging ink based on the drive frequency of the drive driver of purge time amount and a recording head.

[Claim 7] The above-mentioned discharge quantity detection means is ink residue detection equipment according to claim 1 to 4 which carries out counting of the number of regurgitation of a recording head based on the information inputted into the drive driver of a recording head, and detects the discharge quantity of ink.

[Claim 8] It is ink residue detection equipment according to claim 1 to 7 which the above-mentioned suction pump consists of a piston pump, and the amount detection means of suction carries out counting of the count of suction of a piston pump, and detects the amount of suction of ink.

[Claim 9] It is ink residue detection equipment according to claim 1 to 7 which the above-mentioned suction pump consists of a tubing pump, and the amount detection means of suction carries out counting of the rotational frequency of a tubing pump, and detects the amount of suction of ink.

[Claim 10] It is ink residue detection equipment according to claim 1 to 7 which the above-mentioned suction pump consists of a diaphragm pump, and the amount detection means of suction measures the vibration periods of a diaphragm pump, and detects the amount of suction of ink.

[Claim 11] It is the ink residue detection approach of the cartridge which supplies ink to the recording head which makes ink breathe out from a nozzle. The amount of suction of the ink attracted with a suction pump from the nozzle of a recording head when recovering the function of the time of the first stage which exchanged cartridges, and a recording head is detected. The discharge quantity of the ink when purging ink for the discharge quantity of the ink under printing and the nozzle of a recording head from the nozzle of a recording head at a \*\*\*\*\* sake at a normal condition is detected. The ink residue detection approach characterized by computing the ink residue in a cartridge by subtracting the amount of suction and discharge quantity which were detected from the ink total fill or the ink residue computed previously of a cartridge.

[Claim 12] It has the detector which detects the limitation which the actuator displaced with the internal amount of ink and the actuator displaced. It is the ink residue detection approach of the cartridge which supplies ink to the recording head which makes ink breathe out from a nozzle. The amount of suction of the ink attracted with a suction pump from the nozzle of a recording head when recovering the function of the time of

the first stage which exchanged cartridges, and a recording head is detected. The discharge quantity of the ink when purging ink for the discharge quantity of the ink under printing and the nozzle of a recording head from the nozzle of a recording head at a \*\*\*\*\* sake at a normal condition is detected. The ink residue in a cartridge is computed by subtracting the amount of suction and discharge quantity which were detected from the ink total fill or the ink residue computed previously of a cartridge. The ink residue detection approach that an ink residue is characterized by outputting the signal which shows zero when a detector operates with an actuator, while outputting the computed ink residue.

[Claim 13] It has the detector which detects the limitation which the actuator displaced with the internal amount of ink and the actuator displaced. It is the ink residue detection approach of the cartridge which supplies ink to the recording head which makes ink breathe out from a nozzle. The amount of suction of the ink attracted with a suction pump from the nozzle of a recording head when recovering the function of the time of the first stage which exchanged cartridges, and a recording head is detected. Change into the number of regurgitation which detects and carries out the regurgitation of the amount of suction from a nozzle, and the discharge quantity of the ink when purging ink for the discharge quantity of the ink under printing and the nozzle of a recording head from the nozzle of a recording head in the normal condition at a \*\*\*\*\* sake is detected. The ink residue in a cartridge is computed by subtracting the amount of suction and discharge quantity which were detected from the ink total fill or the ink residue computed previously of a cartridge. The ink residue detection approach that an ink residue is characterized by outputting the signal which shows zero when a detector operates with an actuator, while outputting the computed ink residue.

[Claim 14] The ink residue detection approach according to claim 13 which changes and sets beforehand the ink total fill which becomes settled by the capacity of the above-mentioned cartridge as the number of regurgitation, and computes an ink residue from the number of regurgitation according to the ink total fill, and the number of regurgitation from the nozzle of a recording head.

[Claim 15] The ink residue detection approach according to claim 10 to 14 of carrying out counting of the number of regurgitation of the above-mentioned recording head from the number of driving pulses from the drive driver of a recording head, and detecting the discharge quantity of ink.

[Claim 16] The ink residue detection approach according to claim 15 of detecting the discharge quantity of the ink when purging the above-mentioned ink based on the drive frequency of the drive driver of purge time amount and a recording head.

[Claim 17] The ink residue detection approach according to claim 10 to 14 of carrying out counting of the number of regurgitation of an upper recording head based on the information inputted into the drive driver of a recording head, and detecting the discharge quantity of ink.

[Claim 18] The ink jet recording device which carries out the description of having claim 1 thru/or one ink residue detection equipment of 10.

[Claim 19] The ink jet recording device which carries out the description of having claim 1 thru/or one ink residue detection equipment of 10 for every color.

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## DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to improvement in the detection precision of the ink residue detection equipment and the ink residue detection approach of detecting the residue of the ink contained to ink cartridges which have the flexibility which contained the ink supplied to the recording head which injects ink from a nozzle, such as a bag and a container, and an ink jet recording device, especially an ink residue.

[0002]

[Description of the Prior Art] Recording apparatus, such as the printer and facsimile of a recent-years and ink jet injection type, and a copying machine, carry in carriage the ink cartridge and recording head which contained ink in the bag which has flexibility, the container, etc., and scanning carriage to the main scanning direction which are the conveyance direction of the detail paper, and a direction which intersects perpendicularly, from the nozzle of a recording head, the detail paper is made to breathe out the ink supplied from the ink cartridge as an ink droplet, and they print it. In order to be stabilized, to make ink breathe out from a recording head with this ink jet recording device and to make it print suitable for the detail paper, when having not printed, into the nozzle part, the cap was put and the recording head was sealed at the home position, and ink dries or it has prevented a contaminant's adhering and clogging arising for a nozzle. And when ink cartridges are exchanged, ink was attracted from the nozzle with the suction pump linked to the cap put on the nozzle part of a recording head, and the air bubbles contained in the ink in a new ink cartridge or a recording head are removed. Moreover, while printing, also when a dot omission etc. arises, a cap is put on the nozzle part of a recording head, ink is attracted from a nozzle with a suction pump, and he cancels clogging of a nozzle, and is trying to recover the function of a recording head. Furthermore, a cap is put on the nozzle part of a recording head for every fixed period under the time of starting printing actuation, or printing, and he purges ink from a nozzle, and is trying to maintain a nozzle in the normal condition.

[0003] Thus, since printing becomes impossible when the ink in an ink cartridge is lost while printing, for example, as shown in JP,9-169118,A or JP,5-19467,B, the condition that the ink residue in an ink cartridge turned into below the capacity defined

beforehand was detected, and the ink and the signal which show that are outputted and displayed, or are transmitted to host equipment.

[0004] When printing, the ink residue detection equipment shown in JP,9-169118,A subtracted the discharge quantity which carries out the regurgitation from the nozzle of a recording head from the ink total amount in an ink cartridge, and has detected the ink residue in an ink cartridge. Moreover, the ink residue detection equipment shown in JP,5-19467,B has detected the ink residue in an ink cartridge based on the amount of ink which totaled the discharge discharged when canceling clogging of the nozzle of the discharge quantity which carries out the regurgitation from the nozzle of a recording head when printing, and a recording head and recovering a function.

[0005]

[Problem(s) to be Solved by the Invention] However, since the consumption of the ink in an ink cartridge is computed only by the discharge quantity which carries out the regurgitation from the nozzle of a recording head when printing as shown in JP,9-169118,A and the amount of suction at the time of the initial suction actuation for the cellular removal when exchanging ink cartridges or the suction actuation for functional recovery of a recording head is not contained in the consumption of ink, gross errors arise in the detected ink residue. Although he is trying to amend the discharge quantity which a switch is operated, compares the ink residue and the set point which were detected, and carries out the regurgitation from a nozzle in order to cancel this error when the ink residue in an ink cartridge reaches the set point set up beforehand The count of suction actuation for functional recovery of a recording head is not necessarily fixed, and in order to print, the error of about 1 - twenty percent produces the discharge quantity breathed out from the nozzle of a recording head, and the amount of suction for functional recovery. This error will be accumulated and an error will arise in the detected ink residue.

[0006] Moreover, the ink residue detection equipment shown in JP,5-19467,B Since the consumption of the ink in an ink cartridge is computed from the discharge discharged when canceling clogging of the nozzle of the discharge quantity which carries out the regurgitation from the nozzle of a recording head when printing, and a recording head and recovering a function In order to maintain the nozzle of a recording head to the consumption of ink at a normal condition, for every fixed period under the time of starting printing actuation, or printing, the amount of ink when purging ink from the nozzle of a recording head will not be contained, but gross errors will arise in the ink residue detected too.

[0007] This invention improves this demerit and it aims at offering the ink residue detection equipment, the ink residue detection approach, and ink jet recording device which can detect the residue of the ink contained to ink cartridges which have flexibility, such as a bag and a container, with a sufficient precision.

[0008]

[Means for Solving the Problem] The ink residue detection equipment concerning this invention is ink residue detection equipment of the cartridge which supplies ink to the recording head which makes ink breathe out from a nozzle. Have the amount detection means of suction, a discharge quantity detection means, and an ink residue operation means, and the amount detection means of suction detects the amount of suction of the ink attracted with a suction pump from the nozzle of a recording head when recovering the function of the time of the first stage which exchanged cartridges, and a recording head. A discharge quantity detection means detects the discharge quantity of the ink when purging ink for the discharge quantity of the ink under printing, and the nozzle of a recording head from the nozzle of a recording head at a \*\*\*\*\* sake at a normal condition. It is characterized by an ink residue operation means computing the ink residue in a cartridge by subtracting the discharge quantity detected with the amount of suction and discharge quantity detection means which were detected with the amount detection means of suction from the ink total fill or the ink residue computed previously of a cartridge.

[0009] The 2nd ink residue detection equipment concerning this invention It has the detector which detects the limitation which the actuator displaced with the internal amount of ink and the actuator displaced. It is ink residue detection equipment of the cartridge which supplies ink to the recording head which makes ink breathe out from a nozzle. It has the amount detection means of suction, a discharge quantity detection means, an ink residue operation means, and an output means. The amount detection means of suction detects the amount of suction of the ink attracted with a suction pump from the nozzle of a recording head when recovering the function of the time of the first stage which exchanged cartridges, and a recording head. A discharge quantity detection means detects the discharge quantity of the ink when purging ink for the discharge quantity of the ink under printing, and the nozzle of a recording head from the nozzle of a recording head at a \*\*\*\*\* sake at a normal condition. An ink residue operation means computes the ink residue in a cartridge by subtracting the discharge quantity detected with the amount of suction and discharge quantity detection means which were detected with the amount detection means of suction from the ink total fill or the ink residue computed previously of a cartridge. An output means is characterized by an ink residue outputting the signal which shows zero, when a detector operates with an actuator, while outputting the computed ink residue.

[0010] The 3rd ink residue detection equipment concerning this invention It has the amount detection means of suction, the amount conversion means of suction, a discharge quantity detection means, an ink residue operation means, and an output means. The amount detection means of suction detects the amount of suction of the ink attracted with a suction pump from the nozzle of a recording head when recovering the function of the time of the first stage which exchanged cartridges, and a recording head. The amount conversion means of suction is changed into the number of regurgitation



which detects with the amount detection means of suction, and carries out the regurgitation of the amount of suction from a nozzle. A discharge quantity detection means detects the discharge quantity of the ink when purging ink for the discharge quantity of the ink under printing, and the nozzle of a recording head from the nozzle of a recording head at a \*\*\*\*\* sake at a normal condition. An ink residue operation means computes the ink residue in a cartridge by subtracting the discharge quantity detected with the discharge quantity and the discharge quantity detection means which were changed with the amount conversion means of suction from the ink total fill or the ink residue computed previously of a cartridge. An output means is characterized by an ink residue outputting the signal which shows zero, when a detector operates with an actuator, while outputting the ink residue computed with the ink residue operation means.

[0011] The ink total fill which becomes settled by the capacity of a cartridge for the above-mentioned ink residue operation means is beforehand changed and set as the number of regurgitation, and an ink residue may be computed from the number of regurgitation according to the ink total fill, and the number of regurgitation from the nozzle of a recording head.

[0012] Moreover, a discharge quantity detection means is good to carry out counting of the number of regurgitation of a recording head from the number of driving pulses from the drive driver of a recording head, and to detect the discharge quantity of ink.

[0013] Furthermore, a discharge quantity detection means is good to detect the discharge quantity of the ink when purging ink based on the drive frequency of the drive driver of purge time amount and a recording head.

[0014] Moreover, a discharge quantity detection means may carry out counting of the number of regurgitation of a recording head based on the information inputted into the drive driver of a recording head, and may detect the discharge quantity of ink.

[0015] Moreover, counting of the count of suction of a piston pump is carried out, the amount detection means of suction carries out counting of the rotational frequency of a tubing pump, and the amount of suction of ink is detected or it detects [ \*\*\*\* / detecting the amount of suction of ink / it measures the vibration periods of a diaphragm pump and ] the amount of suction of ink.

[0016] The ink residue detection approach concerning this invention is the ink residue detection approach of the cartridge which supplies ink to the recording head which makes ink breathe out from a nozzle. The amount of suction of the ink attracted with a suction pump from the nozzle of a recording head when recovering the function of the time of the first stage which exchanged cartridges, and a recording head is detected. The discharge quantity of the ink when purging ink for the discharge quantity of the ink under printing and the nozzle of a recording head from the nozzle of a recording head at a \*\*\*\*\* sake at a normal condition is detected. It is characterized by computing the ink residue in a cartridge by subtracting the amount of suction and discharge quantity which

were detected from the ink total fill or the ink residue computed previously of a cartridge.

[0017] The 2nd ink residue detection approach concerning this invention It has the detector which detects the limitation which the actuator displaced with the internal amount of ink and the actuator displaced. It is the ink residue detection approach of the cartridge which supplies ink to the recording head which makes ink breathe out from a nozzle. The amount of suction of the ink attracted with a suction pump from the nozzle of a recording head when recovering the function of the time of the first stage which exchanged cartridges, and a recording head is detected. The discharge quantity of the ink when purging ink for the discharge quantity of the ink under printing and the nozzle of a recording head from the nozzle of a recording head at a \*\*\*\*\* sake at a normal condition is detected. The ink residue in a cartridge is computed by subtracting the amount of suction and discharge quantity which were detected from the ink total fill or the ink residue computed previously of a cartridge. While outputting the computed ink residue, when a detector operates with an actuator, an ink residue is characterized by outputting the signal which shows zero.

[0018] The 3rd ink residue detection approach concerning this invention The amount of suction of the ink attracted with a suction pump from the nozzle of a recording head when recovering the function of the time of the first stage which exchanged cartridges, and a recording head is detected. Change into the number of regurgitation which detects and carries out the regurgitation of the amount of suction from a nozzle, and the discharge quantity of the ink when purging ink for the discharge quantity of the ink under printing and the nozzle of a recording head from the nozzle of a recording head in the normal condition at a \*\*\*\*\* sake is detected. The ink residue in a cartridge is computed by subtracting the amount of suction and discharge quantity which were detected from the ink total fill or the ink residue computed previously of a cartridge. While outputting the computed ink residue, when a detector operates with an actuator, an ink residue is characterized by outputting the signal which shows zero.

[0019] In each above-mentioned ink residue detection approach, it is good to carry out counting of the number of regurgitation of a recording head from the number of driving pulses from the drive driver of a recording head, and to detect the discharge quantity of ink. Moreover, it is good to detect the discharge quantity of the ink when purging ink based on the drive frequency of the drive driver of purge time amount and a recording head.

[0020] Moreover, based on the information inputted into the drive driver of a recording head, counting of the number of regurgitation of a recording head may be carried out, and the discharge quantity of ink may be detected.

[0021] The ink jet recording device concerning this invention carries out the description of having ink residue detection equipment of one of the above.

[0022] The 2nd ink jet recording device concerning this invention carries out the

description of having ink residue detection equipment of one of the above for every color.

[0023]

[Embodiment of the Invention] Four ink cartridges to which the printer equipment of the ink jet injection method of this invention contained the ink of each color of Cyanogen C, Magenta M, a yellow Y, and Black Bk, respectively, When printing the image data which has the carriage which carried four recording heads to which it has two or more nozzles and ink is supplied from each ink cartridge, and ink cartridges and recording heads, and is sent from host equipment on the recording paper, Imitating a carriage guide idler and scanning carriage, according to image data, ink is injected on the detail paper sent to the printing section from the nozzle of a recording head, and an alphabetic character and an image are recorded on it.

[0024] The head functional retainer is prepared near the home position of the carriage which scans a recording head. The head functional retainer has the protection suction section and the suction pump which are connected with each recording head. The protection suction section has the cap holder which holds a wrap cap and a cap for the nozzle of the wiper blade which wipes off the nozzle side of each recording head, and each recording head, respectively. This protection suction section can be moved now up and down by elevator styles, such as a spring and a solenoid.

[0025] An ink cartridge has the ink container and residue detection plate which consist of a flat bag which has flexibility, and a switch. A residue detection plate is followed and displaced to deformation of an ink container, and when the ink in an ink container becomes zero, the signal which operates a switch and shows an ink end from a switch is made to output.

[0026] The host interface which delivers and receives host equipment and commands, such as printing directions, in the control section of printer equipment, and receives print data to it, The drive control section which manages actuation of the whole equipment, and the display displayed [ operating state / of printer equipment ], The head drive driver which drives each recording head of Cyanogen C, Magenta M, a yellow Y, and Black Bk according to print data, The pump drive driver which drives the suction pump of the head functional retainer, It has ink residue detection equipment which consists of residue operation part connected to the discharge quantity detecting element connected to the output side of each head drive driver, the amount detecting element of suction and each discharge quantity detecting element which were connected to the output side of a pump drive driver, and the amount detecting element of suction, and the residue output section.

[0027] Each discharge quantity detecting element detects the discharge quantity when purging ink from the nozzle of each recording head, in order to breathe out ink from each recording head for printing or to prevent ink drying with the nozzle of a recording head. When cartridges are exchanged, in order that the amount detecting element of

suction may remove the air bubbles in ink or may recover the ink injection function of each recording head, it detects the amount of suction when attracting ink from each recording head. Whenever residue operation part detects discharge quantity and the amount of suction, it computes the ink residue of each cartridge, and it sends it to the residue output section. The residue output section displays the sent ink residue on a display, or sends it to host equipment.

[0028] Thus, if the residue detection plate of each cartridge is followed and displaced to deformation of the ink container which deforms according to an ink residue, for example, the residue detection plate of the cartridge of Black Bk operates a switch when having repeated printing, detecting and displaying the ink residue for every color, the signal which shows an ink end from a switch will be outputted to the residue output section of Black Bk. The residue output section is outputted to host equipment, and directs exchange of the cartridge of Black Bk while it displays the ink and the signal of a cartridge of Black Bk on a display.

[0029]

[Example] Drawing 1 is the block diagram of one example of this invention. Four ink cartridges 2 to which the printer equipment 1 of an ink jet injection method contained the ink of each color of Cyanogen C, Magenta M, a yellow Y, and Black Bk, respectively as shown in drawing, Four recording heads 3 to which it has two or more nozzles and ink is supplied from each ink cartridge (henceforth a cartridge) 2, It has the conveyance roller 8 which conveys the detail paper in the printing section 7, and the discharge roller 10 which discharges the printed detail paper to a paper output tray 9 from a cartridge 2, the carriage 4 which carried the recording head 3, the medium trays 5a and 5b which contained the detail paper, or the manual bypass table 6. And when printing the image data sent from host equipment on the detail paper, imitating the carriage guide idler 11 and scanning carriage 4, according to image data, ink is injected on the detail paper sent to the printing section 7 with the conveyance roller 8 from the nozzle of a recording head 3, and an alphabetic character and an image are recorded on it.

[0030] Near the home position of the carriage 4 which scans this recording head 3, as shown in the perspective view of drawing 2, the head functional retainer 12 is formed. The head functional retainer 12 has recording heads 3C, 3M, and 3Y, and the protection suction section 13 and the suction pump 14 which are connected with 3Bk. the protection suction section 13 -- each -- the wiper blade 15 which wipes off the nozzle side of recording head 3C-3Bk -- each -- it has the cap holder 17 which holds the wrap caps 16a-16d and Caps 16a-16d for the nozzle of recording head 3C-3Bk, respectively. As for Caps 16a-16d, seal members, such as rubber, are prepared in the open end on top. This protection suction section 13 can be moved now up and down by elevator styles, such as a spring and a solenoid.

[0031] A cartridge 2 has the ink container 21, the residue detection plate 22, a case 23,

and a switch 24, as shown in the perspective view of drawing 3 (a), and the sectional view of (b). As for the ink container 21, heat joining of the ink feed hopper 25 which a polyethylene film laminates inside, consists of a flat bag which has the flexibility which the nylon film laminated outside, and consists of polyethylene is carried out by using an aluminum film as a base material. One side-face 26a pasted the case 23 by the double faced adhesive tape etc., and this ink container 21 has pasted up the residue detection plate 22 on side-face 26b of another side by the double faced adhesive tape etc. The residue detection plate 22 is followed and displaced to deformation of the ink container 21, and when the ink in the ink container 21 becomes zero, the signal which operates a switch 24 and shows an ink end from a switch 24 is made to output.

[0032] The host interface 31 which delivers and receives host equipment 30 and commands, such as printing directions, in the control section of printer equipment 1, and receives print data to it as shown in the block diagram of drawing 4 , The drive control section 32 which has the image memory which memorizes RAM and print data which are used for ROM which memorized the processing program of CPU which manages actuation of the whole equipment, and CPU, the work-piece memory of CPU, etc., the displays 33 to display, such as operating state of printer equipment 1, and print data -- responding -- Cyanogen C, Magenta M, a yellow Y, and Black Bk -- each -- with head drive driver 34C-34Bk which drives recording head 3C-3Bk It has ink residue detection equipment which serves as the pump drive driver 35 which drives the suction pump 14 of the head functional retainer 12 from discharge quantity detecting-element 36C-36Bk, the amount detecting element 37 of suction, residue operation part 38C-38Bk, and residue output section 39C-39Bk.

[0033] discharge quantity detecting-element 36C-36Bk -- each -- the amount of ink injected from a nozzle by 1 time of the regurgitation beforehand set as the value which carried out counting of the number of ink regurgitation of recording head 3C-3Bk, and carried out counting from the number of driving pulses outputted to recording head 3C-3Bk from head drive driver 34C-34Bk -- multiplication -- carrying out -- each -- the discharge quantity of the ink which carries out the regurgitation from the nozzle of recording head 3C-3Bk is detected. Moreover, in order to protect that ink dries with a nozzle from recording head 3C-3Bk, when purging ink, the discharge quantity of ink is detected from purge time amount and the drive frequency of head drive driver 34C-34Bk.

[0034] the time of the amount detecting element 37 of suction exchanging each cartridge 2C-2Bk -- each -- when recovering the function of recording head 3C-3Bk, the amount of suction of the ink attracted with a suction pump 14 from the nozzle of recording head 3C-3Bk is detected. When detecting the amount of suction of the ink attracted with a suction pump 14 by this amount detecting element 37 of suction and the piston pump is being used as a suction pump 14, counting of the count of suction of a piston pump is carried out from the output signal of the pump drive driver 35, the

multiplication of the amount of suction by one suction defined according to the suction capacity of a piston pump is carried out, and the amount of suction of ink is detected. Moreover, when the CHU ping pump which presses a tube by Rota rotated as a suction pump 14 is being used, counting of the number of rotations of a CHU ping pump is carried out from the output signal of the pump drive driver 35, the multiplication of the amount of suction by one rotation defined according to the suction capacity of a CHU ping pump is carried out, and the amount of suction of ink is detected. Furthermore, when the diaphragm pump is being used as a suction pump 14, the vibration periods of a diaphragm pump are measured from the output signal of the pump drive driver 35, the multiplication of the amount of suction for every unit time amount defined according to the suction capacity of a diaphragm pump is carried out, and the amount of suction of ink is detected.

[0035] Residue operation part 38C-38Bk computes the ink residue in each cartridge 2C-2Bk by subtracting the discharge quantity detected by the amount of suction of each cartridge 2C-2Bk of every and discharge quantity detecting-element 36 C-Bk which were detected by the amount detecting element 37 of suction from the ink total fill which becomes settled from the volume of the ink container 21 of cartridge 2C - 2Bk. residue output section 39C-39Bk -- each -- while outputting the ink residue computed by residue operation part 38C-38Bk, when the signal which operates a switch 24 with the residue detection plate 22 of cartridge 2C - 2Bk, and shows an ink end from a switch 24 is outputted, ink and a signal are outputted.

[0036] The actuation when printing exchanging cartridge 2Bk of Black Bk with the printer equipment 1 constituted as mentioned above, and supplying ink to recording head 3Bk is explained with reference to the flow chart of drawing 5 .

[0037] First, cartridge 2Bk carried in carriage 4 is exchanged, carriage 4 is moved to the location of the head functional retainer 12, the protection suction section 13 of the head functional retainer 12 is raised, and each cap 16 is stuck to recording head 3C-3Bk, respectively. And it switches to cap 16d which put connection of a suction pump 14 on recording head 3Bk, and the air bubbles which a suction pump 14 is driven, and only a constant rate attracts ink from the nozzle of recording head 3Bk the first stage, and are contained in ink are removed (step S1). After removing the air bubbles which only a constant rate Ms attracts ink from the nozzle of recording head 3Bk, and are contained in ink, the drive of a suction pump 14 is stopped and it goes into a standby condition (step S2). the time of this standby condition -- every fixed about time amount, for example, 3 hours, -- carriage 4 -- the location of the head functional retainer 12 -- moving -- each -- the nozzle of recording head 3C-3Bk to ink -- purging -- each -- it prevents ink drying with the nozzle of recording head 3C-3Bk (step S3).

[0038] If print data are sent from host equipment 30 in the state of this standby and printing is started by recording head 3Bk, carriage 4 will be moved to the location of the head functional retainer 12, the purge at the time of printing initiation will be performed

from the nozzle of recording head 3Bk, and after that and printing which prevent ink drying with a nozzle (step S5) will be performed (step S6). Recovery action is directed, when printing is started, it checks whether there is any dot omission in the image which the user of printer equipment 1 is printing (step S7) and there is a dot omission. If recovery action is directed, carriage 4 will be moved to the location of the head functional retainer 12, a suction pump 14 will be driven, forcible suction of the ink will be carried out from the nozzle of recording head 3Bk, and the function of recording head 3Bk will be recovered (step S8). whenever [ moreover, / which is made to continue printing since the function of recording head 3Bk is recovered when there is no dot omission and, and is carried out n line printing ] -- carriage 4 -- the location of the head functional retainer 12 -- moving -- each -- it protects from the nozzle of recording head 3C-3Bk that purge ink and ink dries it with the nozzle of the recording heads 3C-3Y which are not used (step S9).

[0039] Thus, while exchanging cartridge 2Bk and drawing in from the nozzle of recording head 3Bk the first stage, the amount detecting element 37 of suction detects the amount Ms1 of suction by the suction pump 14 (step S10). moreover -- waiting -- every fixed time amount -- each -- while discharge quantity detecting-element 36C-36Bk detects the amount MP 1 of purges whenever it purges from the nozzle of recording head 3C-3Bk (step S11), and performing the purge at the time of printing initiation from the nozzle of recording head 3Bk, discharge quantity detecting-element 36Bk detects the amount MP 2 of purges (step S12). Moreover, while printing, in order for discharge quantity detecting-element 36Bk to detect the discharge quantity which carries out the regurgitation from the nozzle of recording head 3Bk (step S13) and to recover the function of recording head 3Bk, while carrying out forcible suction, the amount detecting element 37 of suction detects the amount Ms2 of suction by the suction pump 14 (step S14). furthermore, the time of purging, whenever it carries out n line printing -- discharge quantity detecting-element 36C-36Bk -- each -- the amount Mp2 of purges from the nozzle of recording head 3C-3Bk is detected (step S15).

[0040] Residue operation part 38Bk of exchanged cartridge 2Bk computes the ink residue of cartridge 2Bk by subtracting the amount Ms1 of suction from the ink total fill M0 which becomes settled from the volume of the ink container 21 of cartridge 2Bk, when the amount Ms1 of suction by the suction pump 14 of the amount detecting element 37 of suction is detected. moreover, residue operation part 38C-38Bk of each cartridge 2C-2Bk -- waiting -- every fixed time amount -- each recording heads 3C-3 -- the ink residue of each cartridge 2C-2Bk is computed by subtracting from the ink residue which computed previously the amount Mp1 of purges detected by discharge quantity detecting-element 36C-36Bk whenever it purged from the nozzle of Bk. While displaying this computed ink residue on residue output section 39C-39Bk at a display 33 for every delivery, Cyanogen C, Magenta M, yellow Y, and black Bk, it outputs to host equipment 30 (step 16).

[0041] thus, cartridge 2Bk -- exchanging -- waiting -- each -- maintaining the injection property of recording head 3C-3Bk, the ink residue of each cartridge 2C-2Bk can be detected with a sufficient precision, and can be displayed.

[0042] Moreover, whenever residue operation part 38Bk of cartridge 2Bk which supplies Ink Bk to recording head 3Bk currently used for printing detects the amount Mp2 of purges, and discharge quantity M and the amount Mp3 of purges by discharge quantity detecting-element 36Bk during the time of printing initiation, and printing The ink residue of cartridge 2Bk under printing is computed by subtracting from the ink residue which computed previously the amount Mp2 of purges, and the discharge quantity M and the amount Mp3 of purges which were detected. Furthermore, when forcible suction of the ink is carried out from the nozzle of recording head 3Bk and the function of recording head 3Bk is recovered, the ink residue of cartridge 2Bk under printing is computed by subtracting from the ink residue which computed previously the amount Ms2 of suction detected by the amount detecting element 37 of suction. While displaying this computed ink residue on residue output section 39Bk at delivery and a display 33, it outputs to host equipment 30 (step 16).

[0043] Each residue operation part 38C-38Y of the cartridges 2C-2Y which supply ink to the recording heads 3C-3Y which are not used for printing computes the ink residue of each cartridges 2C-2Y under printing by subtracting it from the ink residue which computed previously the amount Mp3 of purges detected whenever it detected the amount Mp3 of purges by the discharge quantity detecting elements 36C-36Y to each cartridge 2C-2Y of every. Moreover, the ink residue of each cartridges 2C-2Y under printing is computed by subtracting from the ink residue which computed previously the amount Ms2 of suction detected whenever it detected the amount Ms2 of suction of each recording heads 3C-3Y by the amount detecting element 37 of suction, when forcible suction of the ink was carried out and the function of recording heads 3C-3Y was recovered to each cartridge 2C-2Y of every. While displaying this computed ink residue on the residue output sections 39C-39Y at a display 33 at every delivery, Cyanogen C, Magenta M, and yellow Y, it outputs to host equipment 30 (step 16).

[0044] thus, each recording heads 3C-3 -- since the ink residue of each cartridge 2C-2Bk is computed by detecting the discharge quantity and amount of suction whenever it breathes out ink from Bk or attracts ink, the ink residue of each cartridge 2C-2Bk is detectable with a sufficient precision. And the ink residue for every color of printer equipment 1 can be correctly told to a user by displaying the ink residue of each detected cartridge 2C-2Bk on a display 33, or indicating by delivery at host equipment 30.

[0045] Thus, when having repeated printing, detecting and displaying the ink residue for every color If the residue detection plate 22 of each cartridge 2C-2Bk is followed and displaced to deformation of the ink container 21 which deforms according to an ink residue, for example, the residue detection plate 22 of cartridge 2Bk operates a switch



24 The signal which shows an ink end from a switch 24 is outputted to residue output section 39Bk (step S17). Residue output section 39Bk is outputted to host equipment 30, and directs exchange of cartridge 2Bk while it displays the ink and the signal of cartridge 2Bk on a display 33, and printer equipment 1 suspends printing actuation (step 18).

[0046] Thus, since the residue detection plate 22 and switch 24 which are followed and displaced to deformation of the ink container 21 which deforms according to an ink residue detect an ink end, also where each cartridge 2C-2Bk is demounted from printer equipment 1, it can check the existence of ink.

[0047] Counting of the number of ink regurgitation of recording head 3C-3Bk is carried out from the number of driving pulses outputted to recording head 3C-3Bk from head drive driver 34C-34Bk. the above-mentioned example -- discharge quantity detecting-element 38C-38Bk -- each -- The discharge quantity of the ink which carries out the regurgitation from the nozzle of recording head 3C-3Bk is detected. the amount of ink injected from a nozzle by 1 time of the regurgitation beforehand set as the value which carried out counting -- multiplication -- carrying out -- each -- Although the case where the ink residue of each cartridge 2C-2Bk was computed by detecting the amount of suction attracted with a suction pump 14 by the amount detecting element 37 of suction was explained As shown in the block diagram of drawing 6 , the amount transducer 40 of suction is formed, and a division may be done in the amount of ink which injects the amount of suction for every recording head 3C-3Bk detected by the amount detecting element 37 of suction by 1 time of the regurgitation from the nozzle of recording head 3C-3Bk, and you may change into the number of regurgitation of the ink which carries out the regurgitation from a nozzle. The number of ink regurgitation of recording head 3C-3Bk is detected from the number of driving pulses outputted to recording head 3C-3Bk from head drive driver 34C-34Bk. in this case -- each -- discharge quantity detecting-element 38C-38Bk -- each -- the number of regurgitation changed by the amount transducer 40 of suction -- each -- the number of ink regurgitation detected by discharge quantity detecting-element 38C-38Bk to residue operation part 38C-38Bk -- each -- the amount of ink discharged from recording head 3C-3Bk is computed, and the ink residue of each cartridge 2C-2Bk is calculated.

[0048] thus, residue operation part 38C-38Bk -- from the number of regurgitation -- each -- computing the amount of ink discharged from recording head 3C-3Bk -- each -- processing of discharge quantity detecting-element 38C-38Bk -- it can simplify -- each -- the configuration of discharge quantity detecting-element 38C-38Bk can be simplified.

[0049] moreover, the above-mentioned example -- residue operation part 38C-38Bk -- each -- from the number of regurgitation of recording head 3C-3Bk -- each, although the case where the amount of ink discharged from recording head 3C-3Bk was computed was explained If the ink total fill which becomes settled by the capacity of the ink

container 21 of each cartridge 2C-2Bk is beforehand changed into the number of regurgitation and it is set as residue operation part 38C-38Bk the number of regurgitation according to the ink total fill -- each -- an ink residue can be directly computed from the number of regurgitation of recording head 3C-3Bk, and processing of residue operation part 38C-38Bk can be simplified.

[0050] moreover, each above-mentioned example -- each discharge quantity detecting elements 38C-38, although the case where the number of driving pulses outputted to recording head 3C-3Bk from head drive driver 34C-34Bk by Bk detected the number of ink regurgitation of recording head 3C-3Bk was explained it is shown in the block diagram of drawing 7 -- as -- each -- you may make it compute the number of ink regurgitation of recording head 3C-3Bk from the printing data inputted into head drive driver 34C-34Bk by discharge quantity operation part 41C-41Bk, and a purge signal

[0051]

[Effect of the Invention] This invention detects the amount of suction of the ink attracted with a suction pump from the nozzle of a recording head when recovering the function of the time of the first stage which exchanged cartridges, and a recording head, as explained above. The discharge quantity of the ink when purging ink for the discharge quantity of the ink under printing and the nozzle of a recording head from the nozzle of a recording head at a \*\*\*\*\* sake at a normal condition is detected. Since the ink residue in a cartridge was computed by subtracting the amount of suction and discharge quantity which were detected from the ink total fill or the ink residue computed previously of a cartridge, the ink residue of a cartridge is detectable with a sufficient precision.

[0052] Moreover, while outputting the computed ink residue, when a detector operates with the actuator displaced with the internal amount of ink, an ink residue outputs the signal which shows zero and the ink residue of a cartridge can be correctly told to a user by displaying on a display or indicating by delivery at host equipment.

[0053] Thus, since an ink end operates a detector with the actuator displaced according to an ink residue and is detected, also where a cartridge is demounted from a recording device, it can check the existence of ink.

[0054] Furthermore, when recovering the function of the time of the first stage which exchanged cartridges, and a recording head, the amount of ink discharged from a recording head by easy processing can be computed by changing into the number of regurgitation which detects and detects the amount of suction of the ink attracted with a suction pump from the nozzle of a recording head, and carries out the regurgitation of the amount of suction from a nozzle.

[0055] Moreover, an ink residue can be easily calculated by computing an ink residue from the number of regurgitation from the nozzle of a recording head, the changed number of regurgitation, and the number of regurgitation according to the ink total fill.

[0056] Moreover, the discharge quantity of ink is easily detectable by carrying out

counting of the number of regurgitation of a recording head from the number of driving pulses from the drive driver of a recording head, and detecting the discharge quantity of ink.

[0057] Furthermore, the discharge quantity of the ink when purging is detectable with a sufficient precision by detecting the discharge quantity of the ink when purging ink based on the drive frequency of the drive driver of purge time amount and a recording head.

[0058] Moreover, according to the data to print, it is detectable with high precision by carrying out counting of the number of regurgitation of a recording head based on the information inputted into the drive driver of a recording head, and detecting the discharge quantity of ink.

[0059] Furthermore, the amount of suction of ink is detectable with a sufficient precision according to the property of a suction pump by carrying out counting of the count of suction of a piston pump, detecting the amount of suction of ink, or carrying out counting of the rotational frequency of a tubing pump, and detecting it, or measuring and detecting the vibration periods of a diaphragm pump.

[0060] The residue of the ink which can be used for printing according to the amount of ink to consume can be correctly displayed by using this ink residue detection equipment for the printer and facsimile of an ink jet injection method, and a copying machine.

[0061] Moreover, the consumption of the ink for every color and the residue of the ink which can be used for printing can be correctly displayed on the printer and facsimile of an ink jet injection method, and a copying machine by forming ink residue detection equipment for every color.

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## DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]

[Drawing 1] It is the block diagram of the printer equipment of the example of this invention.

[Drawing 2] It is the perspective view showing arrangement of the head functional retainer.

[Drawing 3] It is the block diagram of an ink cartridge.

[Drawing 4] It is the block diagram showing the configuration of the control section of printer equipment.

[Drawing 5] It is the flow chart which shows actuation of the above-mentioned example.

[Drawing 6] It is the block diagram showing the configuration of the control section of the printer equipment of the 2nd example.

[Drawing 7] It is the block diagram showing the configuration of the control section of

the printer equipment of the 3rd example.

[Description of Notations]

1; printer equipment, 2; cartridge, 3; recording head, 4; Carriage, The 12; head functional retainer, 13; protection suction section, 14; A suction pump, 21; ink container, 22; residue detection plate, 24; switch, 30; Host equipment, 31; -- a host interface and 32; -- a drive control section, 33; display, a 34; head drive driver, 35; pump drive driver, 36; discharge quantity detecting element, and 37; -- the amount detecting element of suction, 38; residue operation part, 39; residue output section, the amount transducer of 40; suction, and 41; discharge quantity operation part.